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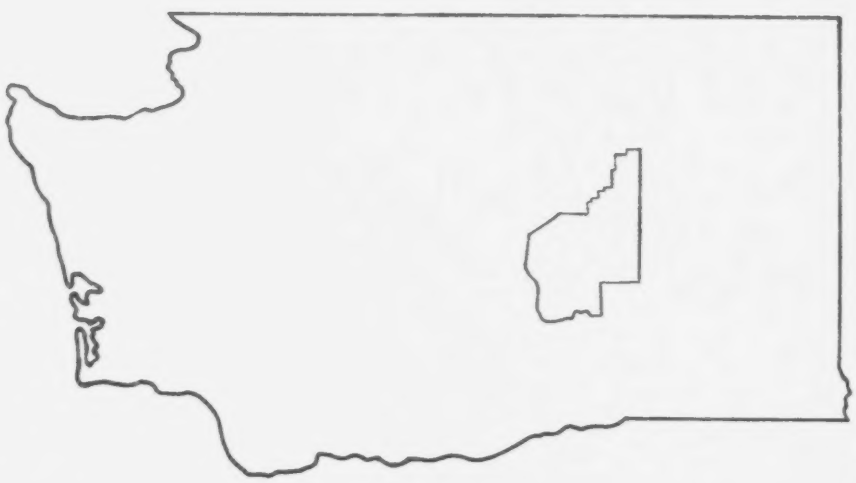
FLOOD INSURANCE STUDY

GRANT COUNTY, WASHINGTON
UNINCORPORATED AREAS



SEPTEMBER 30, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER - 530049

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study may not contain all data available within the repository. Please contact the community repository for any additional data.

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FLOOD INSURANCE STUDY
GRANT COUNTY, WASHINGTON, UNINCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the unincorporated areas of Grant County, Washington, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum NFIP requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE), Seattle District, for streams flowing through the Cities of Moses Lake and Ephrata and the Town of Wilson Creek. The portions of the existing technical and/or scientific data that extend into the unincorporated areas of Grant County were compiled for this Flood Insurance Study. The analyses were performed for the Federal Emergency Management Agency (FEMA), under Interagency Agreement No. IAA-EMW-E-1153, Project Order No. 1. The studies for the Cities of Moses Lake and Ephrata were completed in September 1984. The study for the Town of Wilson Creek was completed in November of the same year.

1.3 Coordination

In July 1982 the streams to be studied were identified during an initial community coordination meeting attended by representatives of the community, FEMA, and the COE (the study contractor).

A request for relevant information concerning flood hazards in Grant County were sent to the Chairman of the Grant County Board of

Commissioners. The study contractor did not receive any new information as a result of this request.

The results of the study were reviewed at the final community coordination meeting on December 7, 1987. This meeting was attended by representatives of the community, FEMA, and the study contractor. No significant changes resulted from these meetings, and the results were acceptable to the community.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the unincorporated areas of Grant County, Washington. The area of study is shown on the Vicinity Map (Figure 1).

The area studied by detailed methods includes the reach of Crab Creek and Parker Horn north of the City of Moses Lake between State Highway 17 and the U.S. Geological Survey (USGS) stream gaging station 3.7 miles upstream. Crab Creek flows into Parker Horn and was studied as one continuous watercourse. Throughout this study it will be referred to as Crab Creek. Wilson Creek and Crab Creek were also studied by detailed methods for a distance of approximately 2.0 miles along the corporate limits of the Town of Wilson Creek. In the City of Ephrata, the overflow from Dry Creek was studied by detailed methods. Some of the resultant overland shallow flooding affects unincorporated areas of Grant County.

The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through 1989.

Approximate 100-year floodplain boundaries were taken directly from the Flood Hazard Boundary Map for the unincorporated areas of Grant County (Reference 1). The scope and methods of study were proposed to, and agreed upon by, FEMA and Grant County.

2.2 Community Description

Grant County is located close to the geographical center of the State of Washington. It is bordered to the east by Lincoln and Adams Counties and to the north, south, and west by Douglas, Benton, and Kittitas Counties, respectively. Grant County is served by many railroads, including the Northern Pacific Railroad, Great Northern Railroad, and Chicago, Milwaukee, St. Paul & Pacific Railroad. Interstate Highway 90 runs east and west across the county through the City of Moses Lake.

The county has a land area of 2,675 square miles and a population density of 18.7 persons per square mile, according to 1986 estimates (Reference 2). This is considerably less than the average of 63 persons per square mile for the entire state.

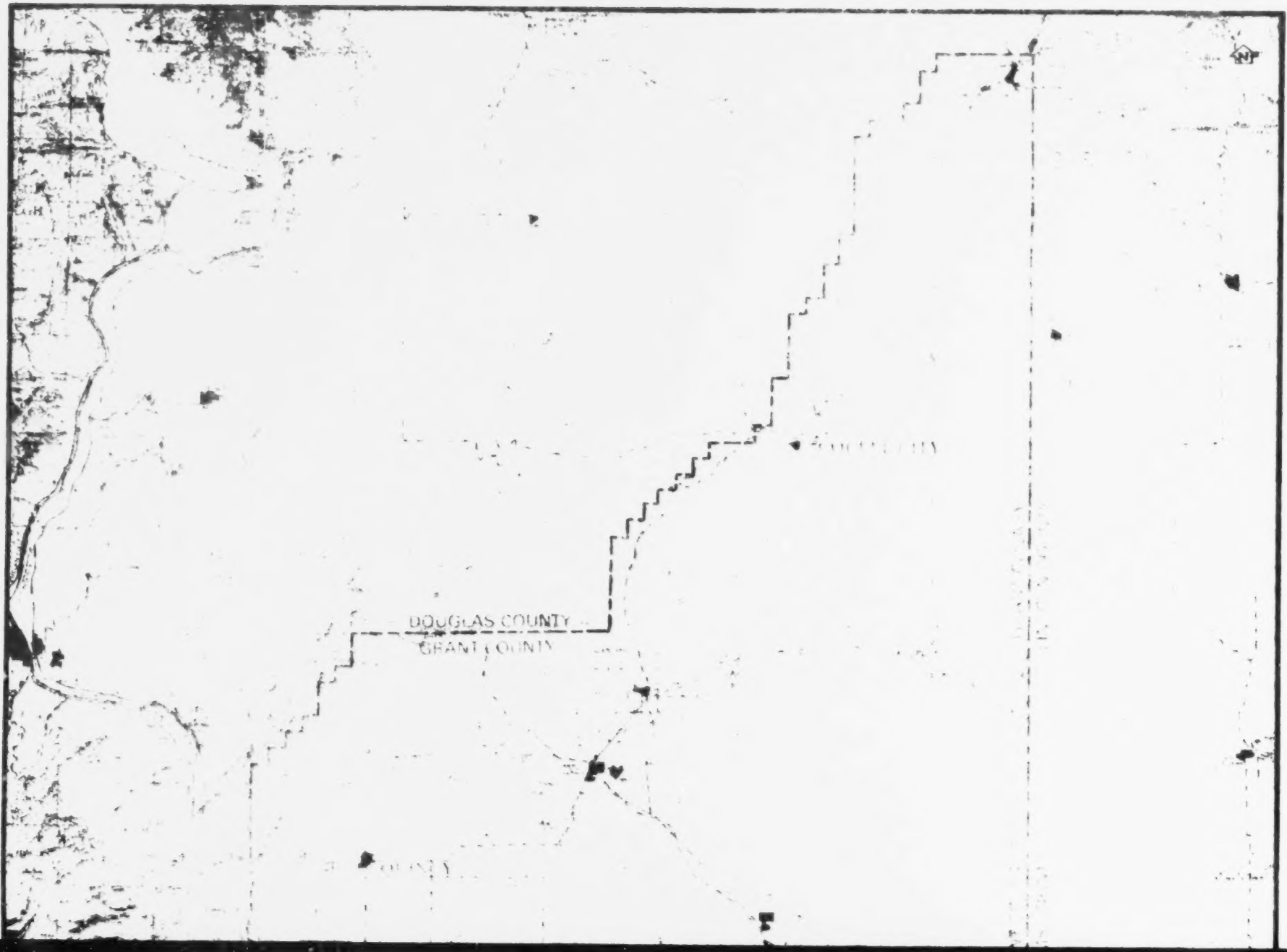
N
DOUGLAS COUNTY
GRANT COUNTY

FIGURE 1

GRANT COUNTY, WA
(UNINCORPORATED AREAS)

VICINITY MAP

According to U.S. Census Bureau data (Reference 3), the population of Grant County increased from 41,881 in 1970 to 48,552 in 1980.

Grant County lies within the Columbia Basin area, and Ephrata (the county seat) is headquarters for the world's largest irrigation project, the Columbia Basin Project. The irrigation project has turned an otherwise arid area into an oasis of lakes and streams. For the most part, Grant County is devoted to agriculture. The topography varies from quite steep and rocky to table top levels. Most of the area is used for irrigated and dryland farming, containing some of the most valuable wheat land in the northwest. The land that is unsuitable for farming is designated uncultivated agricultural land.

The climate varies with elevation, but the overall mean average temperature range in the county is from 49.8°F to 59.9°F and the mean annual precipitation range is from 7.3 to 9.3 inches. The heaviest precipitation occurs during the winter; monthly precipitation ranges from 0.4 inch in July to 1.9 inches in January. Snowfall averages from 37 to 39 inches in the southern portion of the county to 55 inches in the northern portion (Reference 2).

The City of Moses Lake is located in eastern Grant County, Washington and is situated approximately 100 miles west of Spokane. Crab Creek flows from the north into Parker Horn, a tributary to Moses Lake, near the City of Moses Lake.

The City of Ephrata is located in central Grant County, and is situated approximately 110 miles west of Spokane. Dry Creek enters Ephrata at the western corporate limits and is then diverted to a ponding area north of the city.

The Town of Wilson Creek is located in eastern Grant County, and is situated approximately 100 miles west of Spokane. Crab Creek flows generally from the eastern corporate limits to the western corporate limits and is joined by Wilson Creek near the southeast corner of the town.

2.3 Principal Flood Problems

Most flooding problems in the Crab Creek Basin occur from extreme runoff events of short duration. These flash floods are usually caused by heavy rain on snow-covered frozen ground. This type of event will be referred to as a winter rainflood in this study. Severe spring and summer thunderstorms can also cause extensive flooding. Peak flows and estimated recurrence intervals for the four historic major floods that have occurred since 1900 are provided as follows (Reference 4).

Flood	Data From The City of Moses Lake: Peak Flow (cubic feet per second) (cfs)	Data From The City of Moses Lake: Estimated Recurrence Interval (years)	Data From The Town of Wilson Creek: Peak Flow[2] (cfs)	Data From The Town of Wilson Creek: Estimated Recurrence Interval (years)
February 1932	10,000[1]	--	5,000	8
February 1957	10,400	65	12,500	45
January 1959	5,000	20	--[3]	--
February 1963	4,200	16	--[3]	--

[1] Although no measurement was made of the 1932 flood near the City of Moses Lake, long-time local residents recall it having a magnitude similar to the 1957 flood.

[2] Estimated by slope-area measurements

[3] Although no estimates were made of the peak flows for the 1959 and 1963 floods within the Town of Wilson Creek, nearby stream records and descriptions provided by local residents indicate both floods were larger than the 1932 flood.

The February 1957 flood is the largest flood recorded at the City of Moses Lake and the Town of Wilson Creek. Near the City of Moses Lake, bridges were damaged, though Crab Creek did not overflow its banks within the city. The channel through the city could have carried another 2 to 3 feet of water. The flood damaged both the Alder Street and State Highway 17 bridges by eroding the fill material and washing out the abutments. Floating ice aggravated the flooding by creating dams at the bridges and forcing backwater to inundate land adjacent to Crab Creek.

Virtually the entire Town of Wilson Creek, however, was inundated by approximately 4 to 5 feet of water as Wilson Creek overtopped and breached the dike, allowing 80 percent of its flow to pass through the business district. This dike will be overtopped by the 100-year flood. Residences and businesses were damaged extensively, streets were eroded, bridges were washed out, and large sections of the dike were destroyed. The flooding was aggravated by the failure of Bennett's Dam, located approximately 2 miles west of the town, which increased the peak flow on Wilson Creek by approximately 5,000 cfs. Ice and debris jams at narrow bridge openings also aggravated the flooding.

Several floods have occurred on Dry Creek at Ephrata since 1900. The three largest floods occurred in 1901, 1920, and 1948. The 1901 flood was caused by rain combined with snowmelt; the 1920 and 1948 floods were caused by severe thunderstorms. No estimates were made of the peak discharges for the 1901 and 1920 floods. The 1948 flood was reported to be the worst flood in the history of Ephrata, had a peak discharge of 3,080 cfs estimated by slope-area measurements. The estimated recurrence interval is 75 years. This flood was the result of a severe thunderstorm on the evening of May 27. An

8-foot wall of water roared down Dry Creek and broke through the existing diversion dikes at 1st Avenue NW and C Street NW, causing extensive damage. A 60-block area of the city was inundated by water and silt. Basements, streets, lawns, and most of the downtown offices at street level were flooded. Storm sewers that were obstructed by silt aggravated the flooding.

2.4 Flood Protection Measures

No major steps have been taken to mitigate flooding problems in the unincorporated areas of Grant County. Some floodproofing and building restrictions have been implemented. Elevations on Moses Lake are generally lowered at the end of the fall irrigation season to make room for runoff, to protect the boat docks from winter ice, and to clean up the beaches.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the community.

Although thunderstorms can occur in the Crab Creek drainage basin, the large drainage area and stream length and the large amount of natural channel and overbank storage cause the peak to attenuate before reaching Moses Lake. The generally small volume of runoff associated with a thunderstorm would cause only a minimal rise in the lake elevation. Due to these factors, only winter rainfloods

were considered in determining the discharge-frequency relationships for Crab Creek at Moses Lake.

Because serious flooding in the Town of Wilson Creek and the City of Ephrata can occur from either winter rainfloods or summer thunderstorms, a separate discharge-frequency curve analysis was done for each type of flooding. The resulting curves were then combined by standard statistical methods to define the frequency of discharge considering the two types of flooding.

A regional winter rainflood relationship was developed following established guidelines (Reference 5, 6, and 7) by analyzing the peak flows from 25 U.S. Geological Survey (USGS) stream gaging stations for hydrologically similar watersheds in the Columbia River Basin. Because no streamflow data exist for Dry Creek at Ephrata, the winter rainflood discharge-frequency curves for Dry Creek were determined from this analysis.

The peak runoff data from one of these gages (Crab Creek near Moses Lake, USGS station No. 12467000) are more representative of the Crab Creek basin than the regional relationship. This gage accounted for the tendency of streamflows to decrease in magnitude between the Town of Wilson Creek and the City of Moses Lake. The peak runoff data from two other gages (Wilson Creek at Wilson Creek, USGS station No. 12465500, and Crab Creek at Irby, USGS station No. 12465000) are more representative of the Wilson Creek basins than the regional relationship. A statistical analysis of stream gage data for Crab Creek near Moses Lake and for Wilson Creek at Wilson Creek and Crab Creek following the standard log-Pearson Type III method (Reference 6), was used to develop the winter rainflood discharge-frequency curves for Crab Creek at the City of Moses Lake and Town of Wilson Creek as well as for Wilson Creek at the Town of Wilson Creek.

A regional thunderstorm relationship was developed by analyzing thunderstorm floods in the Columbia River basin. This relationship was compared with both the regional winter rainflood and detailed thunderstorm studies made by the COE for Canyons 1 and 2 at Wenatchee, Washington, and Placer Creek, Idaho (References 8 and 9, respectively). Both comparisons verified the reasonableness of the regional thunderstorm analysis. The thunderstorm discharge-frequency curves for Dry Creek at Ephrata and Wilson Creek were determined from this analysis.

Peak discharge-drainage area relationships for Crab Creek, Wilson Creek and Dry Creek are shown in Table 1.

TABLE 1. SUMMARY OF DISCHARGES

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cfs) 10-Year	50-Year	100-Year	500-Year
Crab Creek					
Downstream of confluence with Rocky Coulee Wasteway	2,306	3,300	9,450	14,100	32,700
At USGS gaging station, 3 miles north of Moses Lake	2,009	2,960	8,800	13,200	31,000
Downstream of confluence with Wilson Creek	1,765	5,850	13,100	17,500	28,600
At upstream corporate limits	1,338	5,300	12,000	15,700	26,100
Wilson Creek					
At mouth	427	3,900	8,900	12,000	21,500
Dry Creek					
At West Canal crossing	26	1,080	2,550	3,500	7,000

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Two hydraulic analysis cases were studied to determine which caused greater flooding: a primary flood on Wilson Creek with coincidental flows on Crab Creek, or a primary flood on Crab Creek with coincidental flows on Wilson Creek. The analysis revealed that the first combination caused flooding of greater magnitude. The limits of this flooding are shown on the Flood Insurance Rate Map (Exhibit 2).

Cross sections for the backwater analysis of Crab and Wilson Creeks were obtained from aerial photographs flown on March 16, 1983, at a

scale of 1:12,000 (Reference 10). Cross sections for the backwater analysis of Dry Creek were obtained in April 1983. All bridges, dams, and culverts were field checked to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments where a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Insurance Rate Map (Exhibit 2).

Roughness factors (Manning's "n") used in the hydraulic computations were chosen using engineering judgment and based on field observations of the streams and floodplain areas. Roughness values for the main channel of Crab Creek near Moses Lake ranged from 0.030 to 0.06, while floodplain roughness values ranged from 0.035 to 0.050 for all floods. Roughness values for the main channels of Wilson and Crab Creeks ranged from 0.039 to 0.062, while floodplain roughness values ranged from 0.044 to 0.090 for all floods. Roughness values for the channel of Dry Creek ranged from 0.035 to 0.080.

Water-surface elevations of floods of the selected recurrence intervals were computed through use of the COE HEC-2 computer program (Reference 11) for Crab Creek near Moses Lake and the COE G3722110 Water-Surface Profiles computer program (Reference 12) for Crab and Wilson Creeks near the Town of Wilson Creek. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for Crab Creek were calculated using the slope-area method.

Hydraulic analyses of Dry Creek at Ephrata and vicinity have revealed that a major portion of the City of Ephrata is located on the Dry Creek alluvial fan and is subject to sheetflow. Flooding will occur when flow overtops the diversion channel immediately upstream and downstream of the arch culvert at 1st Avenue NW and G Street. Generally, the banks of this channel are in fair condition; however, there are a few locations where erosion has occurred, resulting in a side slope that is steeper than desirable. A significant amount of aggradation appears to have occurred in the vicinity of the arch culvert. The hydraulic analysis has shown that the capacity of the arch culvert is approximately 2,000 cfs; however, the channel immediately upstream and downstream of the culvert is approximately 1,500 cfs, with 3 feet of freeboard on the right bank levee.

The 100-year flood event on Dry Creek would overtop the channel banks in the vicinity of the arch culvert and result in sheetflow, with flooding approximately 1 foot deep throughout the alluvial fan. Another source of flooding during the 100-year event is from the depression located north of the Ephrata corporate limits that would receive the residual discharge from Dry Creek. When the water surface at the depression reaches an elevation of 1,267 feet,

water will overflow easterly and flow overland into Crab Creek. At this elevation, portions of the City of Ephrata and the adjoining area of Grant County are flooded.

The determination of flooding in alluvial fans is highly probabilistic, in that the probability with which a flood occurs at the apex of the fan does not define the probability of flooding at any point on the fan. A discrete floodpath over the fan will be dictated by fixed and random conditions; thus, any portion of the fan is subject to potential flooding during a flood event. Therefore, for insurance purposes, the entire alluvial fan is shown as sheetflow with an average depth of 1 foot.

A number of possible flowpaths from the Dry Creek arch culvert overflow point were analyzed for this study. The hydraulic characteristics of the flow were approximated by using the COE Backwater Program G3722040 to analyze the strip flowpaths originating at the apex and terminating at the base of the fan (Reference 13). The flowpaths and analysis were based on field inspections of existing conditions on the alluvial fan at Ephrata, historical flooding conditions, the effects of the ground slope, and existing development, including residential and other structures and roads. The approximate hydraulic characteristics (depth, velocity, etc.) were then used as a guide to develop the Flood Insurance Study work map.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum (NGVD) of 1929. Elevation reference marks used in this study are shown on the maps; the descriptions of the marks are presented in Elevation Reference Marks (Exhibit 3).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations

determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4,800, with a contour interval of 4 feet (Reference 14).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map (Exhibit 2). On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, and AO); and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Approximate 100-year floodplain boundaries in the study area were taken directly from the Flood Hazard Boundary Map for the unincorporated areas of Grant County (Reference 1).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated at selected cross sections (Table 2). In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Parker Horn								
A	-173	516/180[2]	6,024	2.3	1,053.3	1,053.3	1,054.1	0.8
B	-13	126	1,745	8.1	1,053.0	1,053.0	1,053.7	0.7
C	20	145	2,027	7.0	1,054.1	1,054.1	1,054.8	0.7
D	490	105	1,403	10.1	1,054.0	1,054.0	1,055.0	1.0
E	550	341	1,501	9.4	1,054.7	1,054.7	1,055.3	0.6
F	580	1,010	11,229	1.3	1,056.8	1,056.8	1,057.2	0.4
Crab Creek (Near the City of Moses Lake)								
G	2,310	336	3,963	3.6	1,056.9	1,056.9	1,057.3	0.4
H	5,020	478	3,326	4.2	1,057.7	1,057.7	1,058.5	0.8
I	6,470	652	1,934	7.3	1,063.7	1,063.7	1,064.1	0.4
J	7,930	795	3,994	3.5	1,066.6	1,066.6	1,067.6	1.0
K	9,825	510	3,558	3.7	1,068.1	1,068.1	1,068.8	0.7
L	11,785	336	2,157	6.1	1,069.4	1,069.4	1,070.2	0.8
M	13,255	406	2,517	5.2	1,072.2	1,072.2	1,072.7	0.5
N	14,555	632	3,279	4.0	1,073.6	1,073.6	1,074.3	0.7
O	16,935	526	2,984	4.4	1,075.8	1,075.8	1,076.7	0.9
P	18,675	480	2,816	4.7	1,078.3	1,078.3	1,079.3	1.0

[1]Feet from Chicago, Milwaukee, St. Paul and Pacific Railroad
[2]Width/Width Within County Boundary

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

PARKER HORN - CRAB CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Crab Creek (Near the Town of Wilson Creek)								
A	-2,160	745	7,156	2.5	1,277.8	1,277.8	1,278.3	0.5
B	-1,260	689	6,479	2.7	1,278.0	1,278.0	1,278.5	0.5
C	-200	601/591[2]	5,282	3.3	1,278.5	1,278.5	1,279.0	0.5
D	740	972/282[2]	6,813	2.6	1,279.3	1,279.3	1,279.8	0.5
E	1,615	1074/444[2]	6,673	2.6	1,279.7	1,279.7	1,280.2	0.5
F	2,245	1011/381[2]	7,854	2.2	1,280.1	1,280.1	1,280.5	0.4
G	3,105	1185/515[2]	10,999	1.6	1,280.5	1,280.5	1,280.9	0.4
H	3,705	2012/862[2]	16,332	1.1	1,280.6	1,280.6	1,281.0	0.4

[1]Feet Above Western Corporate Limits of Town of Wilson Creek
[2]Width/Width Within County Boundary

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANT COUNTY, WA
(UNINCORPORATED AREAS)

FLOODWAY DATA

CRAB CREEK

between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

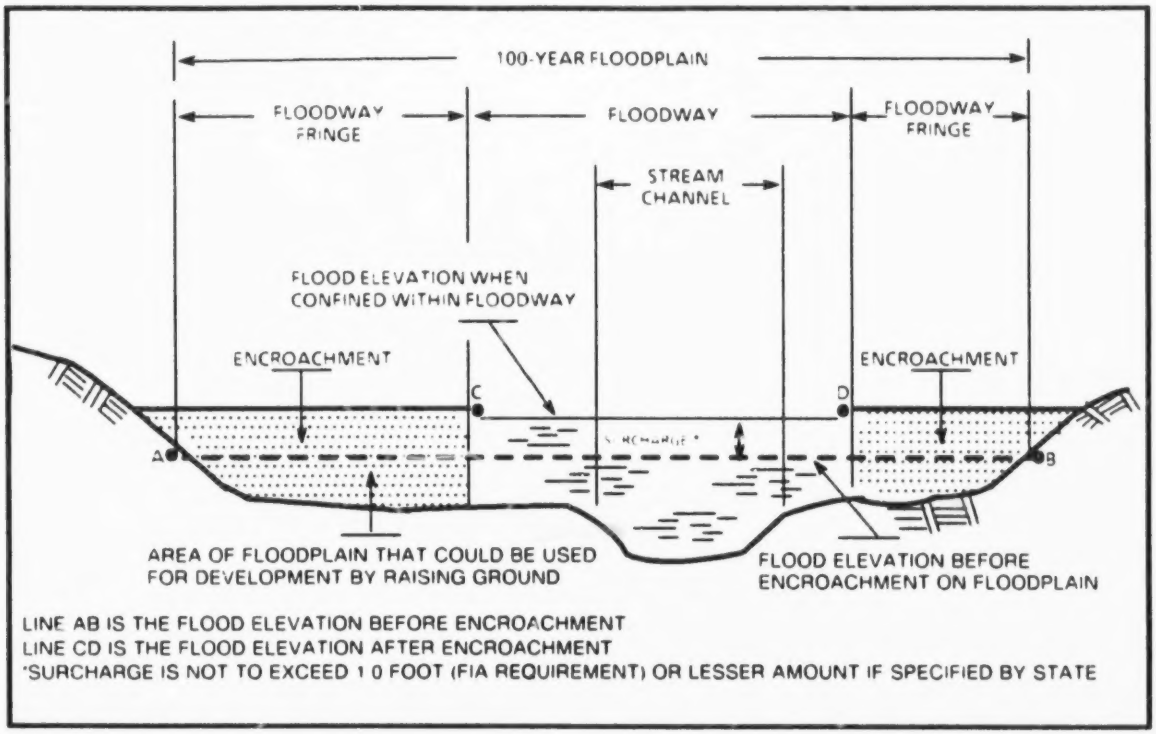
100-YEAR FLOODPLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
A
B
AREA OF FLOODPLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOODPLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1 0 FOOT (FIA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

Figure 2. Floodway Schematic

Floodways are generally not determined for alluvial fan areas due to the shallow depth and unpredictability of the path of flow. Consequently, no floodway has been computed for Dry Creek near Ephrata.

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not

performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 100-year shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 100- and 500-year floodplains, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

The Seattle District of the COE produced preliminary studies for flood control for the Town of Wilson Creek in 1958 and 1972.

Flood Insurance Studies are currently being processed for the Town of Wilson Creek, and the Cities of Ephrata, and Moses Lake, Washington

(References 15, 16, and 17), and are in agreement with the Flood Insurance Study.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Federal Regional Center, 130-228th Street, S.W., Bothell, Washington 98021-9796.

9.0 BIBLIOGRAPHY AND REFERENCES

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16. Federal Emergency Management Agency, Flood Insurance Study, City of Ephrata, Grant County, Washington (unpublished).

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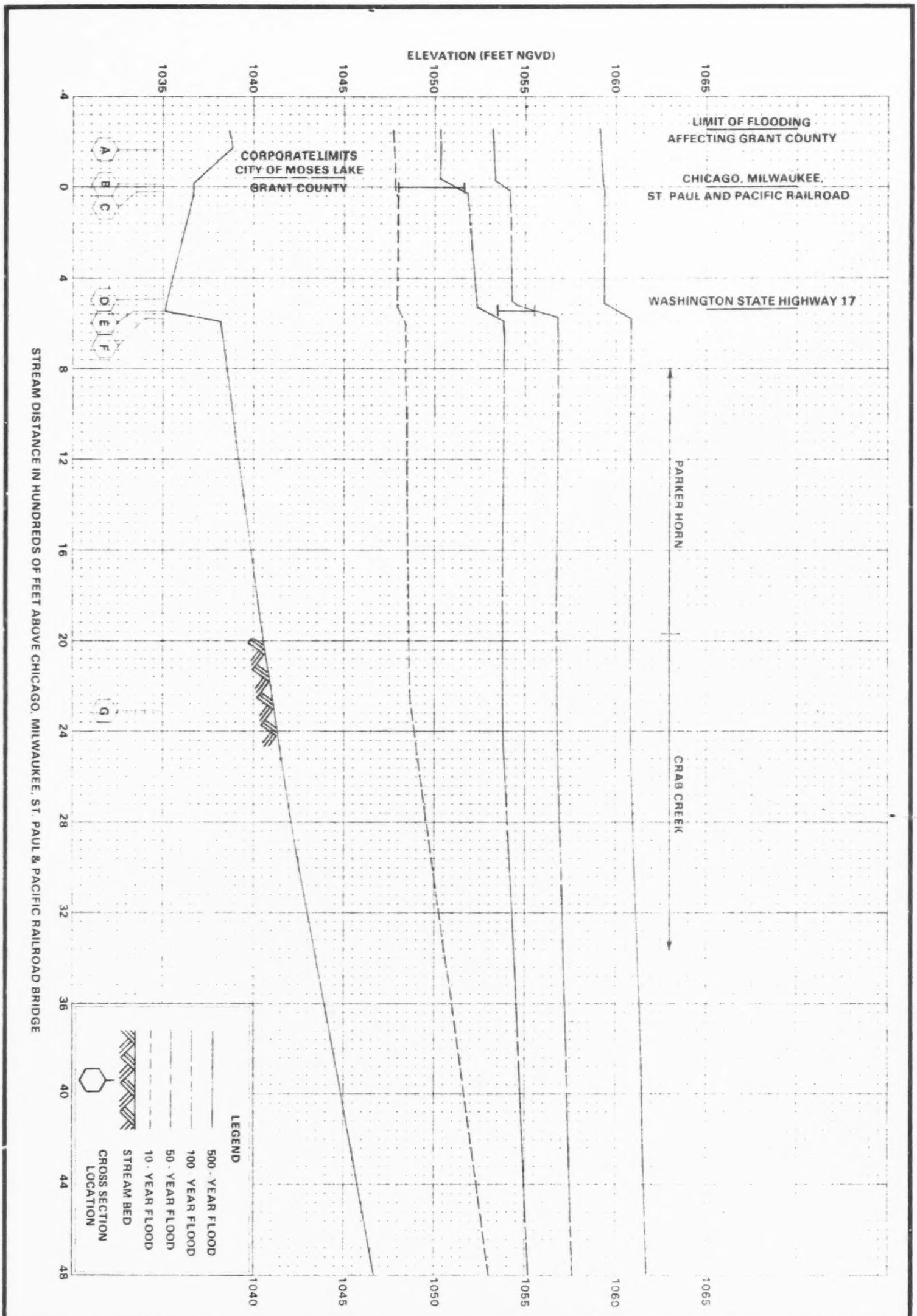


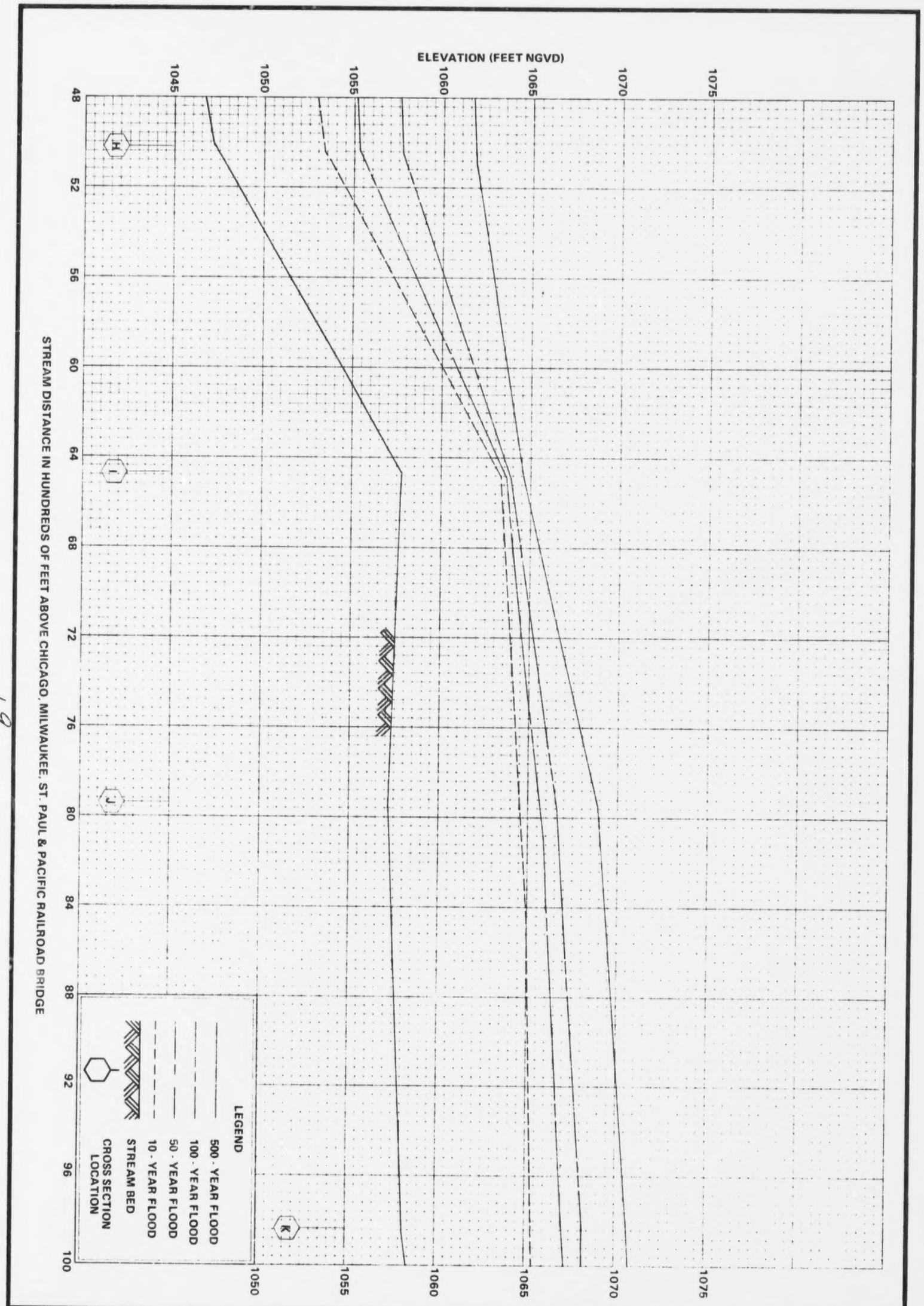
01P

FEDERAL EMERGENCY MANAGEMENT AGENCY

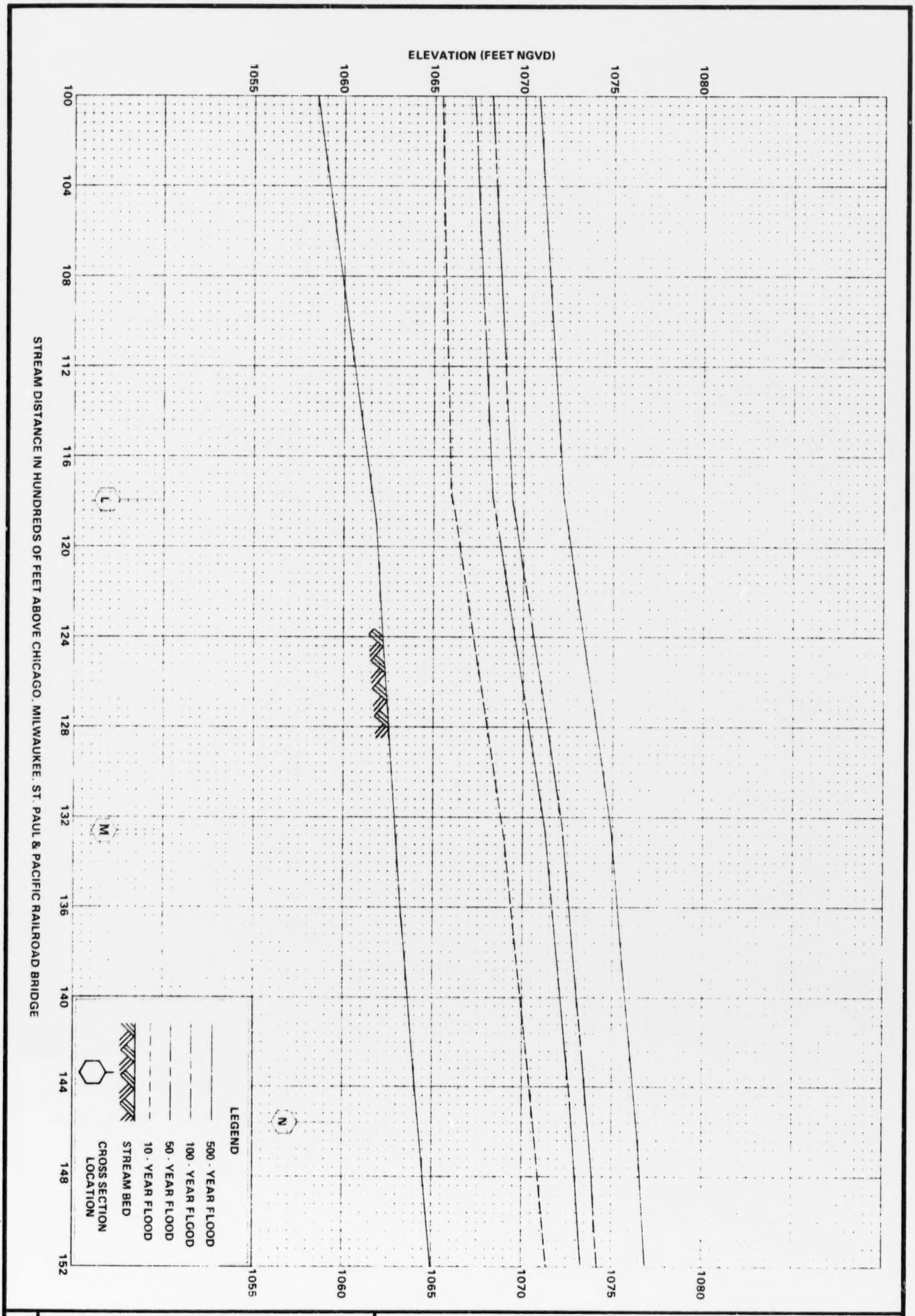
GRANT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

PARKER HORN/CRAB CREEK



02P	FEDERAL EMERGENCY MANAGEMENT AGENCY GRANT COUNTY, WA (UNINCORPORATED AREAS)	FLOOD PROFILES CRAB CREEK NEAR THE TOWN OF MOSES LAKE



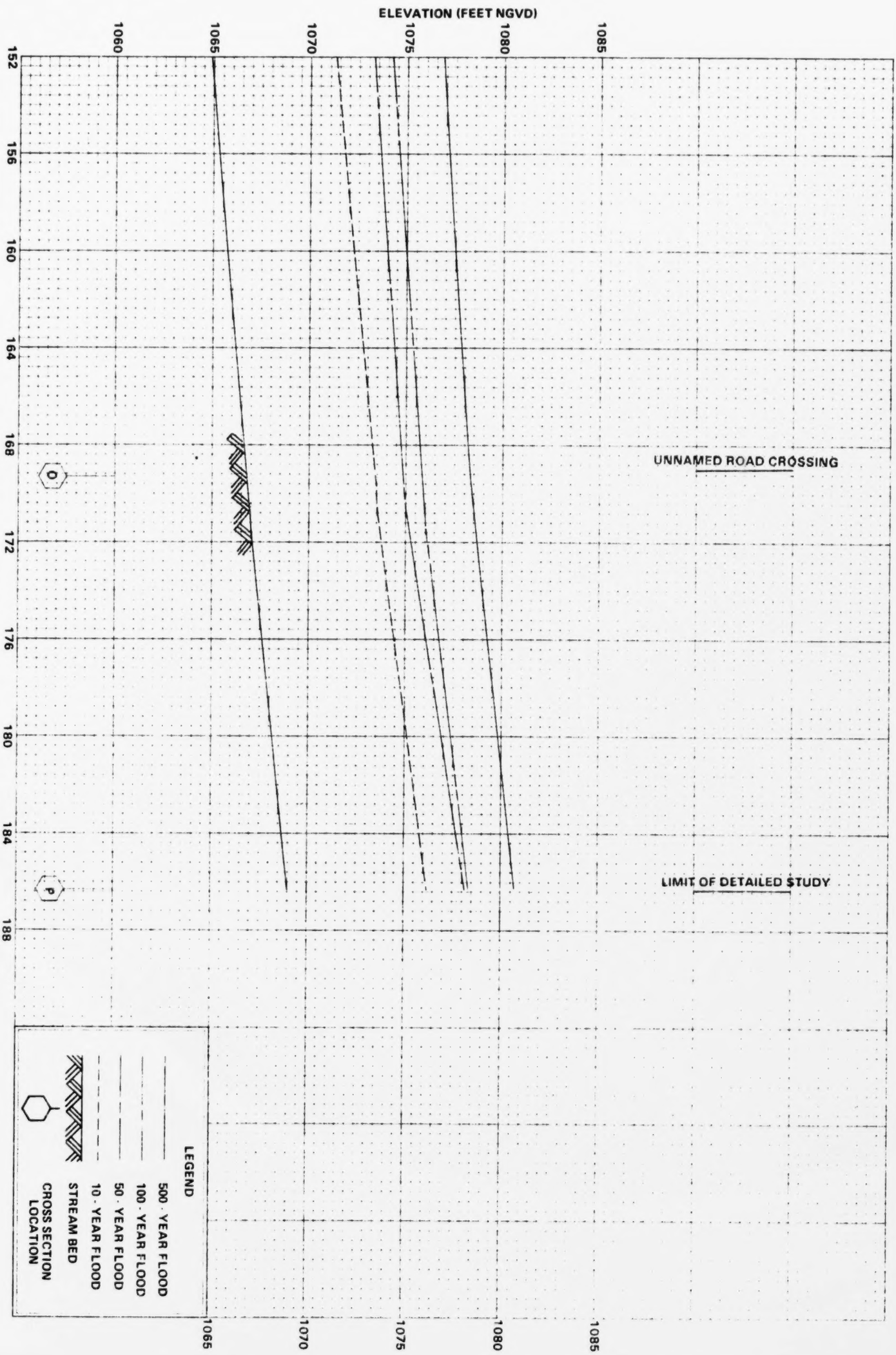
03P

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

CRAB CREEK NEAR THE TOWN OF MOSES LAKE



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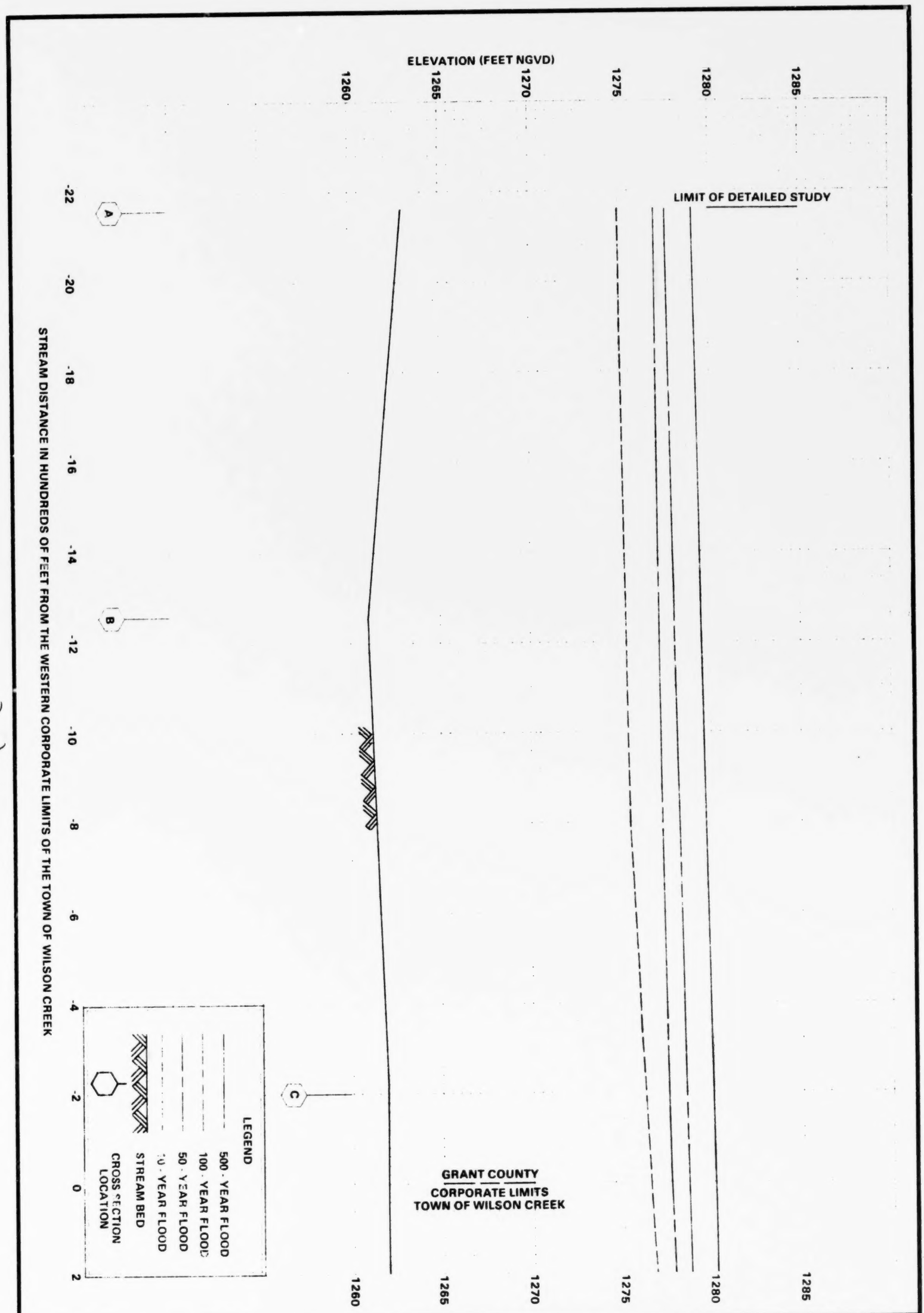


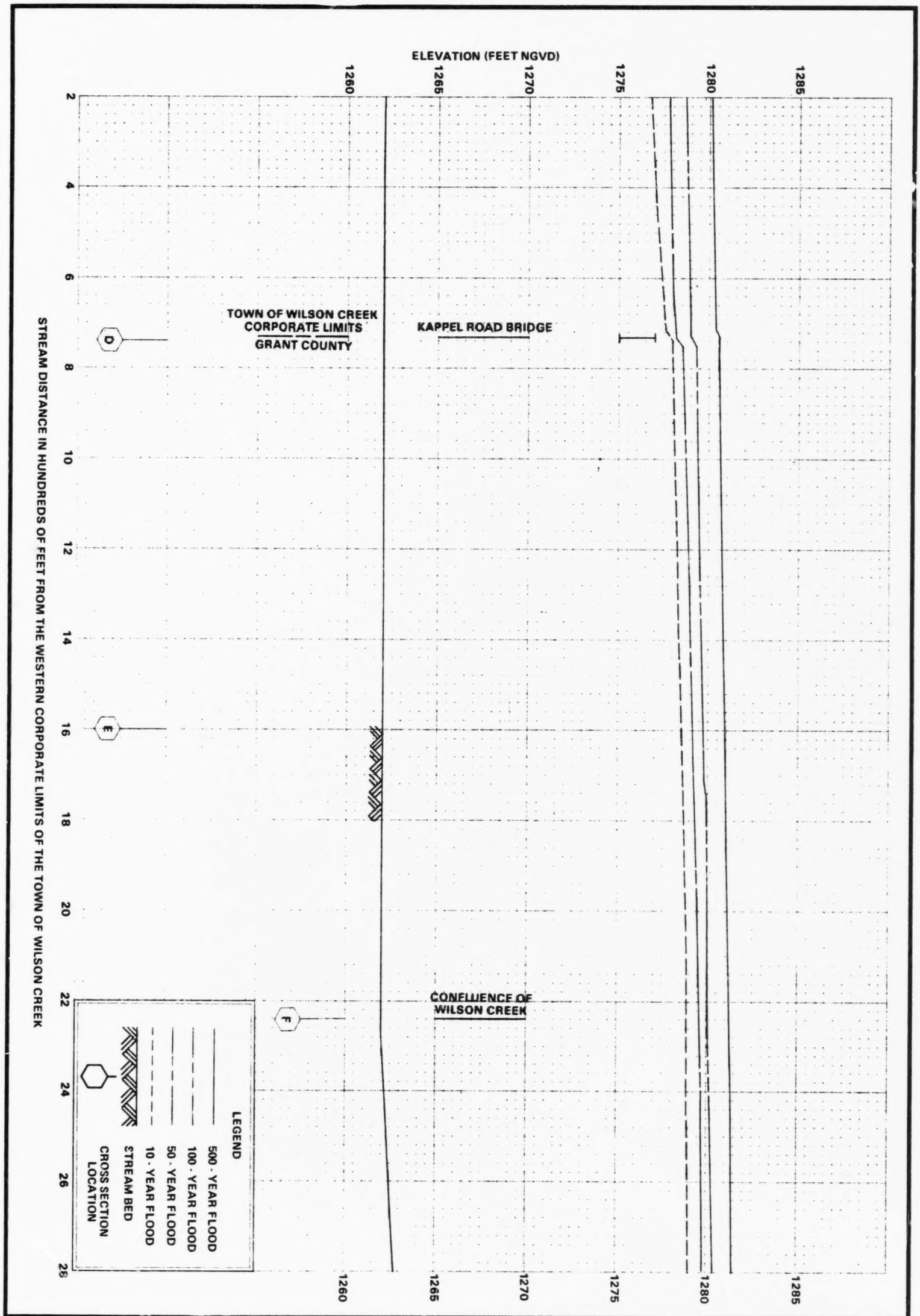
05P

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

CRAB CREEK NEAR THE TOWN OF WILSON CREEK



23

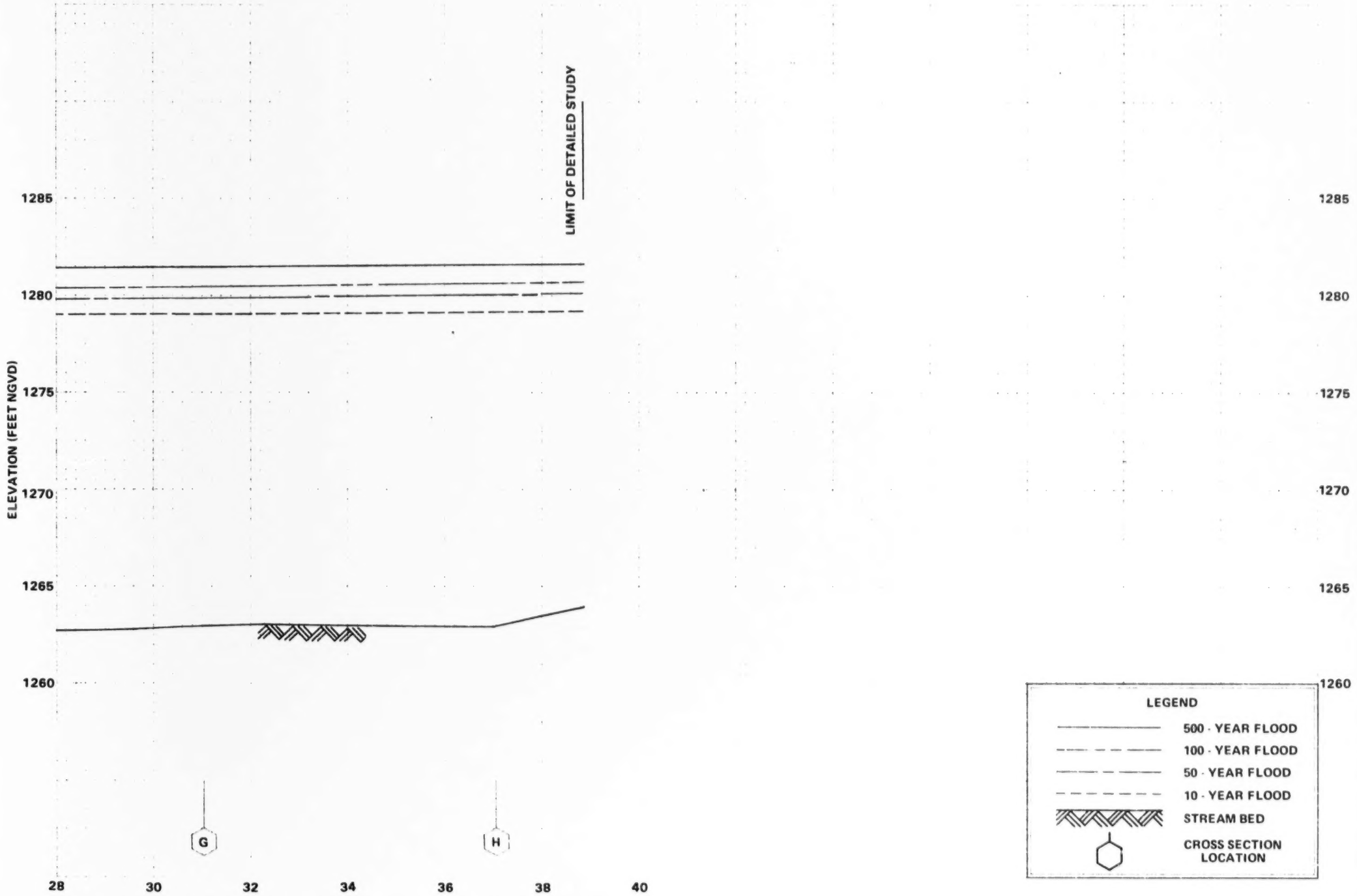
06P

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANT COUNTY, WA
(UNINCORPORATED AREAS)

FLOOD PROFILES

CRAB CREEK NEAR THE TOWN OF WILSON CREEK



FLOOD PROFILES

CRAB CREEK NEAR THE TOWN OF WILSON CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

GRANT COUNTY, WA
(UNINCORPORATED AREAS)

07P

EXHIBIT 3 - ELEVATION REFERENCE MARKS
GRANT COUNTY, WASHINGTON, (UNINCORPORATED AREAS)

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 1	1,324.22	Approximately 930 feet west of the intersection of Sixth and Navar Streets at northern edge of Navar Street on corner walk at west end of the school yard within the corporate limits of the Town of Wilson Creek.
RM 2	1,381.70	P.K. nail at west end of centerline stripe, approximately 1,300 feet northwest of West Canal on Sage Brush Flats Road west of the City of Ephrata corporate limits.